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REPORT ON SANITARY SURVEY OF THE UPPER ARKANSAS RIVER BASIN, NOVEMBER 15-19, 1948

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REPORT ON SANITARY SURVEY

OF THE UPPER ARKANSAS RIVER BASIN

November 15-19, 1948

By

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16. Abstracts

A survey of the Upper Arkansas River Basin was made during the period of November 15-19, 1948, to evaluate public health problems to be encountered in connection with the initial development of the Gunnison-Arkansas Project. This project in Colorado had irrigation as its main purpose. Consideration was given to: topography, climate, channel characteristics, population, flow data, agriculture, industry, stream pollution problems, domestic and industrial water supplies, benefits, recreation areas, and the construction phase of the project. Recommendations for the project are also made.

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REPORT ON SANITARY SURVEY OF THE UPPER ARKANSAS RIVER BASIN

A survey of the Upper Arkansas River Basin was made during the period of November 15-19, 1948, to evaluate public health problems to be encountered in connection with the initial development of the Gunnison-Arkansas Project.

Description of Project. The Gunnison-Arkansas Project, proposed by the Bureau of Reclamation and located in the southern half of Colorado, encompasses 30 per cent of the state's area. The Eastern Slope project area includes all or parts of 18 counties on both sides of the Arkansas River. Six of these counties along the main stem of the river contain about 75 per cent of the irrigated land that would benefit directly from the imported water. The Eastern Slope project area contains 26,150 square miles, or 16,736,000 acres in a 340-mile by 170-mile irregularly-shaped block.

The Arkansas River rises high above timberline on the Eastern Slope of the snow-capped Rocky Mountains near Leadville, at elevations of 10,500 to 14,400 feet. The river flows through the mountains in a southerly direction to a point just beyond Salida, where it turns eastward into a canyon, flows through the deep, scenic Royal Gorge, and emerges into the foothills 128 miles below its headwaters. The river enters the gently rolling, high plains region at Pueblo and continues its easterly course to the Colorado-Kansas boundary, where it leaves the project area at elevation 3,350 feet.

The Gunnison-Arkansas Transmountain Diversion Project provides for the collection and transportation of unallocated surplus water from the Roaring Fork and Gunnison rivers on the Western Slope of the Continental Divide to the Eastern Slope, where it is needed for irrigation of land in the arid plains of southeastern Colorado. Although the main purpose of the project

is irrigation, it will serve also for the production of hydroelectric energy, municipal purposes, flood control, sediment detention, and recreational purposes.

In general, the initial development proposed for the Gunnison-Arkansas Project shown on the attached map provides for the average annual collection of 60,000 acre-feet of water in the Colorado River watershed, its diversion to the Eastern Slope through transmountain tunnels, and replacement storage on the Western Slope. The principal features in the initial development plan include construction of diversion facilities on the Fryingpan River, enlargement of the existing Sugarloaf and Twin Lakes reservoirs, and the construction of the Pueblo Reservoir. This plan also includes a system of canals reaching from the headwaters of the Arkansas River north of Leadville to a point near Salida, Colorado, to serve power plants and irrigated lands.

Topography. About 17 per cent of the Eastern Slope area is above 8,000 feet in altitude and is principally mountainous; about 45 per cent ranges in elevation from 5,000 to 8,000 feet and is hilly except for small, scattered tracts of farm land. The remaining 38 per cent is below 5,000 feet elevation and constitutes the nearly level plains region which is almost entirely used for agricultural purposes.

Climate. Wide climatic variations exist between mountains and plains. The mountainous regions on both sides of the Continental Divide are subhumid with extremely short growing seasons. The measure of precipitation on the Eastern Slope ranges from a yearly average of 18.63 inches at Leadville, to 12.43 inches at Salida. The average annual temperature at Leadville is 35.6° F., with a maximum of 86° F. and a minimum of -29° F. The plains region eastward from Pueblo is arid and rainfall is deficient for optimum

crop production. The average annual precipitation at Canon City, Pueblo, and Lamar is 12.98, 11.67, and 16.05 inches, respectively. Minimum temperatures on the plains are around -30° F., and the maximums are in the neighborhood of 98° F. at Colorado Springs, to 114° F. at Las Animas. The plains area has a long growing season and the frost-free period ranges from 173 days at Pueblo, to 161 days at Las Animas, and 168 days at Lamar, the general average for this region being 165 days.

Channel Characteristics. The slope of the Arkansas River through the plains area between Pueblo and Holly, Colorado, averages about nine feet per mile. In the mountain regions, the slope between Leadville and Pueblo averages about 35 feet per mile. The river mileages, drainage areas, elevations, and stream slopes are presented in the following table:

Location	Miles West of Colo.-Kansas Border	Drainage Area Square Miles	Elevation-Feet Above Mean Sea Level	Slope Feet per Mile
Leadville	310		10,200	
*Granite	291	431	8,915	67.5
*Salida	249	1,210	7,051	44.4
*Canon City	193	3,090	5,344	30.4
*Pueblo	153	4,730	4,690	16.4
*La Junta	89	12,200	4,040	10.1
*Lamar	32	19,800	3,605	7.6
*Holly	4	25,000	3,378	8.1

* Gauging Stations

The river is confined to a narrow channel until it reaches the plains area in the vicinity of Pueblo, and from this point to the Colorado-Kansas border the flood plain covers a wide area and the channel is not well defined. Under normal flow conditions, the Upper Arkansas River is relatively shallow, especially in the plains area. The surface aeration that takes place in the stream under these conditions is an important factor in the natural purification of the wastes that reach the river.

Population. The total population of the Eastern Slope area was 278,700 in 1940. Only about one-half of the total population of the Eastern Slope area was urban during the last census.

Flow Data. The following table shows the stream flow in acre-feet for several Upper Arkansas gauging stations for the period 1911-1944, inclusive:

Item	Granite	Salida	Pueblo	La Junta	Holly
Miles west of Colorado-Kansas border	291	249	153	89	4
Minimum monthly average flow	4,100	12,300	15,700	3,800	8,600
Maximum monthly average flow	70,700	120,200	130,000	60,900	53,200
Average annual flow	229,600	433,100	513,100	222,400	252,000
Average monthly flow during irrigation season (May-September, inclusive)	37,040	64,140	73,880	31,560	34,100

NOTE: The minimum and maximum monthly average flows generally occur in February and June, respectively.

The minimum monthly average flows for the period 1911-1944 inclusive for several gauging stations are as follows: Granite, January, 1918 - 2,500 acre-feet; Salida, April, 1940 - 9,800 acre-feet; Pueblo, April, 1940 - 4,000 acre-feet; La Junta, February, 1921 - 583 acre-feet; and Holly, September, 1926-

76 acre-feet.

Agriculture. Agricultural production on the Eastern Slope, both as to types of crops and yields, is widely diversified due to the variations of soils, altitude, growing season, precipitation, irrigation developments, and other factors. Under these conditions, the economy of the Arkansas Basin within the project boundaries is based primarily upon agricultural production.

Both irrigation and dry farming are practiced in this region. Livestock raising is carried on in conjunction with farming. Grazing is conducted on the plains and in the foothills and mountains, while winter feeding is largely carried out on the valley farms and ranches where forage crops are produced. The highest and most valuable crop production is attained in the irrigated lands adjacent to the Arkansas River and its tributaries between Canon City, Colorado, and Garden City, Kansas. Irrigated farming, dry farming, and livestock raising utilize 74 per cent of the total drainage basin area. In addition, the woodland regions account for about 3 per cent of the drainage area.

The principal crops are forage, sugar beets, melons, fruit, grains, and truck crops. A major public health problem arises in the irrigation of truck crops during low flow periods where irrigation ditches below communities discharging untreated and partially treated sewage divert practically all of the stream flow for irrigation purposes. Truck crops such as celery, cabbage, and lettuce, which are eaten in the raw state, become a public health hazard under these conditions.

Industry. Next to agriculture, mining is the most important industry in the Upper Arkansas River Basin. The principal products are coal, molybdenum, gold, silver, copper, lead, and zinc. Other minerals produced are fluorspar, mica, tungsten, feldspar, manganese, aluminum, and petroleum.

Manufacturing has been slow to develop in the basin despite the prevalence of raw materials. The largest manufacturing plant in the valley is the Colorado Fuel and Iron Company at Pueblo, Colorado. Sugar factories are located at Sugar City, Swink, and Rocky Ford. There are also small local industries engaged in brewing, canning, oil refining, mining, smelting, and in the production of meat, milk, and milk products. In general, the quantity of water is adequate for existing industries, but east of Pueblo the quality is poor and softening is required before the water is suitable for boiler use. From the standpoint of water usage by industry, the railroads are the largest consumers. The next largest industrial consumer is the Colorado Fuel and Iron Company at Pueblo, Colorado, where average annual usage from 1927 to 1940 was 44,200 acre-feet. Of this amount, 38,300 acre-feet was diverted from the Arkansas River, and 36,500 acre-feet was returned to the river after being used for industrial purposes. In general, a better quality of water is required for industrial use than is at present available in the valley.

Stream Pollution Problems. There are thirteen communities with a combined population of 47,464 discharging raw sewage, and four communities with a combined population of 80,450 (1940 census) that discharge partially treated sewage to the Arkansas River and its tributaries within the project boundaries. Available information indicates that there has been an increase of from 25 to 50 per cent in population in most of the communities referred to since 1940. Information regarding the sewerage systems and methods of sewage treatment for these communities is presented in Table I. Observation of the Arkansas River in the lower reaches of the stream on November 15 and 16 revealed that the discharge of raw sewage below the larger communities was approximately equal in volume to the stream flow.

TABLE I

INVENTORY OF WATER AND SEWAGE FACILITIES
MAJOR UPPER ARKANSAS BASIN COMMUNITIES

Community	Pop. (1940)	Water Works		Sewer Sys.	Sewage Treatment	
		Source of Supply	Treatment		Treatment	Discharge to:
Aguilar	1,397	Springs	None	S	None	Apishapa R.
Buena Vista	779	Creek	P-Fc	None		
Canon City	6,690	Arkansas R.	P-Ca-Cl-Dc	S	None	Arkansas R.
Colo. Springs	36,789	Mt. streams	P-Fr-Dc-Ng	S	Primary treatment & Chemical Precip.	Fountain Cr.
Eads	700	Wells	None	S	Primary treatment	
Florence	2,632	Spring & Creek	P-Fp	S	None	Arkansas R.
Fowler	922	Springs	Dc	S	None	Arkansas R.
Holly	864	Deep wells	None	S	None	Arkansas R.
La Junta	7,040	Wells	Dc	S	None	Arkansas R.
Lamar	4,445	Wells & Clay Cr.	Dc	S	None	Arkansas R.
Las Animas	3,232	Wells	None	S	None	Arkansas R.
La Veta	879	Cucharas R.	None	S	Primary treatment	Cucharas R.
Leadville	4,774	Arkansas R.	None	S	None	Arkansas R.
Ordway	150	Wells	None	S	None	Meredith L.
Portland	377	Arkansas R.	P-Ca-Cl-Fp Dc	S	Complete treatment	Arkansas R.
Pueblo	52,162	Arkansas R.	S-C-Dc	S	Primary treatment	Arkansas R.
Rocky Ford	3,494	Arkansas R.	P-Fr Dc	S	None	Arkansas R.
Salida	4,969	Wells & infiltration gallery	Dc	S	None	Arkansas R.
Trinidad	13,223	N. Fork Lake & Creek	None	S	Complete treatment	Purgatoire R
Walsenburg	5,855	Cucharas R.	Ca-S-Fr-Dc	S	None	Cucharas R.

S - Separate (sanitary sewage and industrial waste)

KEY TO WATER WORKS DATA

Type of Plant

P	Purification
D	Disinfection

Treatment or Device

C	Chemical dosage for coagulation or softening
Ca	with alum
Cl	with lime
D	Disinfection
Dc	with chlorine gas
F	Filters
Fp	rapid sand (pressure)
Fr	rapid sand (gravity)
Fc	roughing
N	Ammoniation
Ng	with ammonia gas
S	Sedimentation
C	Chemical (other than chlorine residual)

Although the preliminary survey indicated that complete treatment of the sewage from all sewered communities listed in Table I appears to be needed to provide water of desirable quality for irrigation and domestic purposes, a detailed investigation is considered essential to determine bacteriological, chemical, and other pollution loadings, specific stream uses, and dilution benefits. A study of this nature will provide specific information upon which the degree and extent of waste treatment and remedial measures required can be more firmly established.

According to the 1940 census, there are eighteen unsewered communities with populations ranging from 575 to 97 located in the Arkansas Basin west of the Kansas-Colorado border. When these communities are provided with sewerage systems, adequate treatment of the sewage should be required by the Colorado State Department of Public Health.

Untreated industrial wastes are an important factor in the pollution of the Arkansas River and its tributaries, and the industries that contribute the major sources of pollution are listed in Table II. For the most part, industrial wastes receive little or no treatment prior to being discharged, with the exception of the wastes that empty into community sewerage systems where treatment has been provided. The most apparent effects of industrial waste pollution on the main stem of the river are observed below Leadville, Colorado, where tailings from the smelters and mine drainage can be observed for a considerable distance downstream.

The effects of pollution are quite noticeable in irrigation ditches below the larger communities during low flow periods. Water from these ditches is used by cattle as well as for irrigation, and in some cases the water is utilized for domestic purposes by farm laborers.

TABLE II

INDUSTRIAL WASTE DISPOSAL

ARKANSAS RIVER BASIN

Waste	Company	Location of Plant	Treatment at Source	Discharge to
Brewery	Walters Brewing Co.	Pueblo	None	City sewerage system*
	Hicory & La Crosse	Pueblo	None	City sewerage system*
	Walters Brewing Co.	Trinidad	None	City sewerage system*
Canning	Canon City Canning Company	Canon City	None	City sewerage system
	Fremont Pkg. Co.	Canon City	None	City sewerage system
	Diven Packing Co.	Fowler	None	City sewerage system
	Western Canning Co.	La Junta	None	Arkansas River
	Scaff Bros. Co.	La Junta	None	City sewerage system
	Boston Food Products	Pueblo	None	City sewerage system*
	Rector Food Products	Pueblo	None	City sewerage system*
Meat Products	Royal Gorge Pkg. Co.	Canon City	None	Arkansas River
	Colorado Pkg. Co.	La Junta	None	Arkansas River
	Riverside Pkg. Co.	La Junta	None	Arkansas River
	Creaghe Pkg. Co.	Lamar	None	City sewerage system
	Lamar Custom Slaughtering Plant	Lamar	None	City sewerage system
	Linc[illegible] Pkg. Co.	Pueblo	None	City sewerage system*
	Pueblo Pkg. Co.	Pueblo	None	City sewerage system*
	Sparky's Pkg. Co.	Pueblo	None	City sewerage system*
	Valley Pkg. Co.	Pueblo	None	City sewerage system*
	Stauffer Pkg. Co.	Rocky Ford	None	City sewerage system
	Pavetti Pkg. Co.	Trinidad	Grease trap & cesspool	Subsurface
	Trinidad Pkg. Co.	Trinidad	None	Purgatoire River

TABLE II (Cont.)

Waste	Company	Location of Plant	Treatment at Source	Discharge to
Milk and Milk Products	Colo. Cheese Co.	La Veta	None	City sewerage system*
	Colo. Cheese Co.	Trinidad	None	City sewerage system*
Metal Products	Colo. Fuel & Iron	Pueblo	None	Arkansas River
	American Smelting & Refining Co.	Leadville	None	Overflow to Arkansas River
	Resurrection Mining Company	Leadville	Ponding	Overflow to Arkansas River
	Henm Mining and Milling Co.	Leadville	Ponding	Overflow to Arkansas River
	Colorado Fluorspar Co.	Salida	None	Tailings deposited bank of Ark. River
	Chaffee County Fluorspar Co.	Salida	None	Tailings deposited bank of Ark. River
	U. S. Fluorspar Company	Salida	None	Tailings deposited bank of Ark. River
Rendering Works	La Junta Rendering Co.	La Junta	None	Arkansas River
	Pueblo By-Products Co.	Pueblo	None	City sewerage system*
Sugar	American Crystal Sugar Co.	Rocky Ford	Ponding	Overflow to Arkansas River
	National Sugar [illegible] Co.	Sugar City	None	Lake Meredith
	Holly Sugar Corp.	Swink	Ponding	Overflow to Ark. R.
Railroad	Atchison, Topeka, & Santa Fe R.R. Shops	La Junta	None	Arkansas River
Cattle Cars	Railroad Contractors	La Junta		Bank Arkansas River

* Industrial wastes conveyed to City sewage disposal plant where treatment is provided.

Observations in the field reveal that the indiscriminate discharge of untreated domestic and industrial wastes is responsible for extensive pollution of the Arkansas River and its tributaries. This problem will become more acute in the future with the increase in population and industrial expansion unless a water pollution abatement program is initiated in the near future. Under existing conditions, the water from the Arkansas River is of inferior quality for irrigation, domestic, and industrial purposes, and for the propagation of fish life.

The problems referred to can only be solved by proper treatment of all domestic and industrial wastes prior to their discharge into the Upper Arkansas River and its tributaries. Since water pollution abatement is a responsibility of the State Board of Health, every effort should be made by this agency to solve these problems as soon as possible.

The lack of factual information regarding the effects of the pollution load upon the quality of Arkansas River water within the project boundaries indicates that a detailed stream pollution study should be made over a period of at least one year in order to determine the extent of pollution so that corrective measures can be initiated.

Domestic and Industrial Water Supplies. The sources of water supply and the methods of water treatment for the communities in the Upper Arkansas River Basin are listed in Table I. The quality of water on the Western Slope varies from excellent to good, and supplies are considered adequate for present and anticipated needs. The quantity on the Eastern Slope is barely adequate at present, and shortages are expected in most of the larger cities. In general, the quality is poor from a bacteriological and chemical standpoint, and in many towns the water must be treated for

industrial use. With the future population increase expected to result from potential agricultural and industrial developments, additional water will be needed by many communities, particularly Pueblo and Colorado Springs. Pollution of the Arkansas River and its tributaries by domestic and industrial wastes involves more extensive treatment of the water for domestic and industrial purposes at additional cost than would otherwise be required if all wastes were properly treated prior to their discharge into the river.

Leadville, Canon City, Portland, Pueblo, and Rocky Ford obtain water direct from the Arkansas River for domestic purposes. Although the water is treated in all of these communities with the exception of Leadville, the methods of treatment are not considered adequate in all cases. The following communities obtain water for domestic purposes from tributaries of the Arkansas River, where the pollution load is limited: Buena Vista, Florence, Walsenburg, Colorado Springs, Trinidad, and Lamar.

Benefits. The quality of water which will be diverted from the Fryingpan River will be excellent. The addition of this water to the Arkansas River during the irrigation season will provide additional dilution and thus improve the quality of the Arkansas River water. Although some improvement of the water will be noted by dilution from the Fryingpan River, pollution of Arkansas River water by domestic and industrial wastes will still be extensive and adequate treatment of these wastes is considered essential before the river water will be considered desirable for irrigation, domestic, and industrial purposes.

The initial development provides for a supplemental municipal water supply of 5,700 acre-feet for Pueblo and Colorado Springs. Although the quantity of municipal water will not supply the full amount estimated to be required by these communities in 1985, critical shortages of the present and

near future would be greatly alleviated.

About 3,000 acre-feet of additional water, together with the 21,000 acre-feet now being diverted from the Arkansas River, could be supplied annually to Pueblo from the proposed Pueblo Reservoir. In order to maintain the quality of water for Pueblo at a reasonable level during periods of low streamflow, large quantities of water of excellent quality will be stored at the source and used during the critical periods for dilution of the source of supply immediately above Pueblo. Since the hardness of the raw water at Pueblo ranges from 137 to 428 p.p.m., the dilution to be provided by the Fryingpan River will reduce the hardness to a reasonable level and it will also improve the bacteriological quality of the raw water. Under these conditions, the City of Pueblo should be able to provide proper treatment with a smaller volume of chemicals, which will result in a considerable saving to the City.

Additional water for other towns in the Arkansas Valley below Pueblo could be made available at the potential Pueblo Reservoir by reducing the amount of imported water for supplemental irrigation use.

The John Martin Reservoir on the Arkansas River below Las Animas, Colorado, has a maximum capacity of 655,000 acre-feet, 385,000 of which has been allocated to irrigation use, and 270,000 to flood control. The prolonged storage provided by the reservoir, which is equivalent to more than the average annual flow at La Junta, Colorado, is an important factor in the natural purification of the wastes that are discharged into the river above this unit. Unfortunately, the natural purification that takes place in the reservoir is nullified by the discharge of untreated domestic and industrial wastes to the river below the reservoir at Lamar and Holly, Colorado.

Recreational Areas. The Twin Lakes and Sugarloaf reservoir sites lie within a region of outstanding mountain scenery where excellent opportunities for outdoor recreation exist. Both sites lie partially within the boundaries of San Isabel National Forest in Lake County. Twin Lakes and Sugarloaf reservoirs are located about 16 miles south and 6 miles northwest of Leadville, respectively. The areas in the vicinity of Twin Lakes and Turquoise Lake, the sites for the proposed Twin Lakes and Sugarloaf reservoirs, have been popular recreational areas for many years, and when more water is impounded in these areas, recreational facilities will undoubtedly expand. In connection with the development of recreation facilities in the vicinity of proposed impoundments, precautions should be taken to control the disposal of wastes from the areas to keep pollution from entering the reservoirs. The watersheds of the Arkansas and Colorado rivers and their tributaries above and below impoundments should be considered first from the standpoint of their value in furnishing water of desirable quality for irrigation and domestic purposes, and second from the standpoint of recreational development. No difficulty should be encountered in controlling pollution that originates at the recreational areas if accepted sanitation standards are enforced. A policy should be adopted to prohibit the direct discharge of raw sewage or untreated septic tank effluent to the watersheds of reservoirs. Under favorable conditions it will be possible to dispose of domestic wastes from recreational developments by means of individual disposal plants that provide facilities for settling of the solids and subsurface disposal of the effluent at a safe distance from the high water level of reservoirs. In the absence of water carriage sewerage systems, approved type sanitary pit privies should be required when these units can be properly located with respect to adjoining bodies of water.

Construction Phase of Project. In connection with the construction and operation of camps that will be required during the development phase of the project, certain precautions should be taken by the contractors to protect employees and to prevent stream pollution. Problems to be encountered will include: adequate housing, development of a safe water supply, proper disposal of domestic wastes, adequate garbage and refuse disposal, insect and rodent control, proper operation and maintenance of adequate food handling facilities, and a safe source of milk supply. Since these facilities and supplies should conform to accepted requirements, these problems should be referred to the State Board of Health or the Public Health Service so that these standards can be enforced.

RECOMMENDATIONS

In view of the foregoing, it is recommended that:

1. A detailed stream pollution study of the Upper Arkansas River be made over a period of at least one year in order to determine the extent of pollution so that corrective measures can be initiated.

2. Proposed plans of recreational areas be referred to the Public Health Service for review and comments.

3. sources of water supply for recreational developments and summer homes be required to meet the Public Health Service Drinking Water Standards.

4. Facilities for the disposal of sewage and excreta be provided at recreation areas and summer homes in accordance with standards to be established for this purpose.

5. Subsurface disposal fields be located at least 100 feet from any water supply, and 25 feet from any stream or reservoir, except where

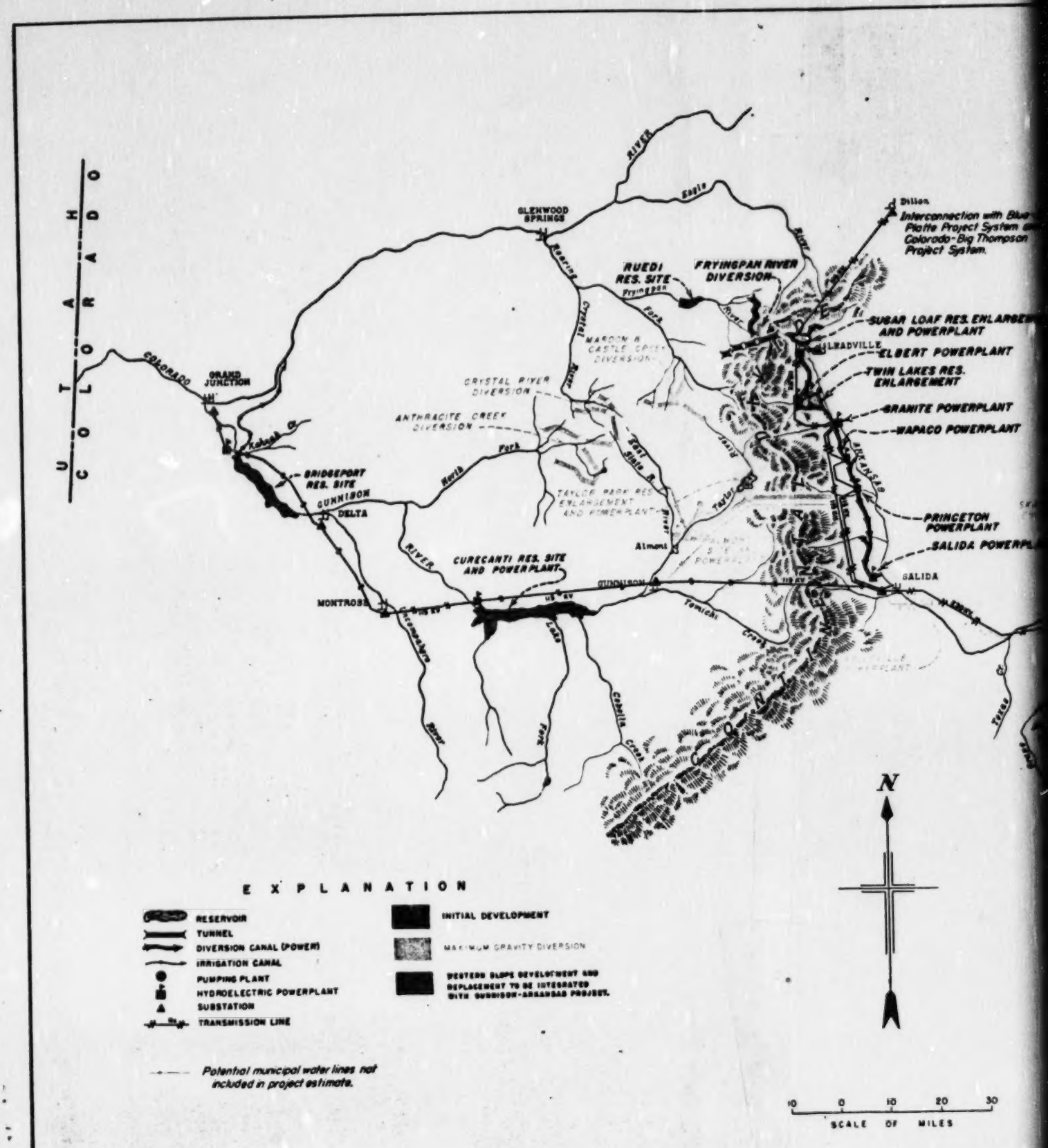
knowledge of local conditions such as soil formation and topography indicates the need for greater separation.

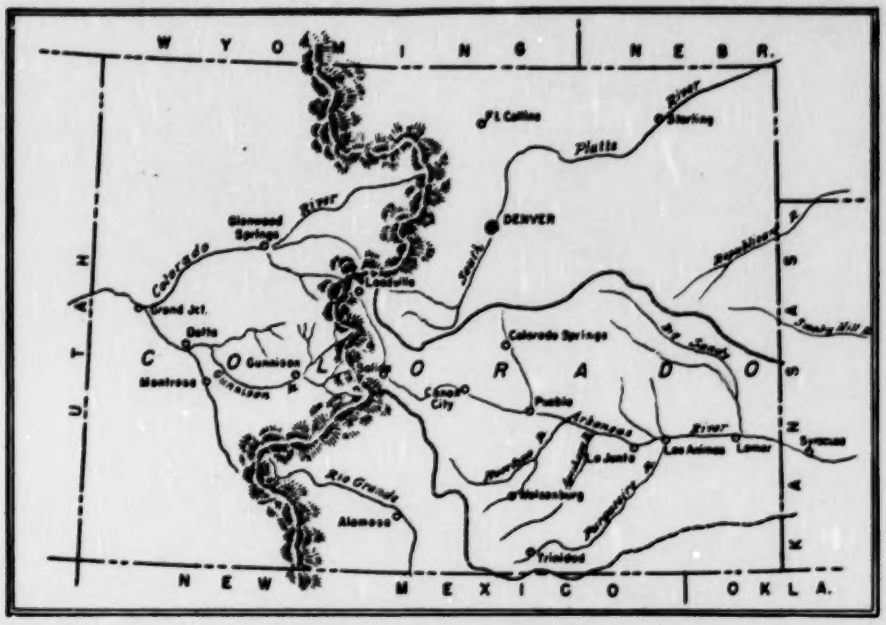
6. Under ordinary conditions, pit privies be located at least 50 feet from any well, spring, or other source of water supply.

7. Wastes from existing and proposed sewerage systems within the project boundaries be adequately treated prior to their discharge into the Upper Arkansas River and its tributaries.

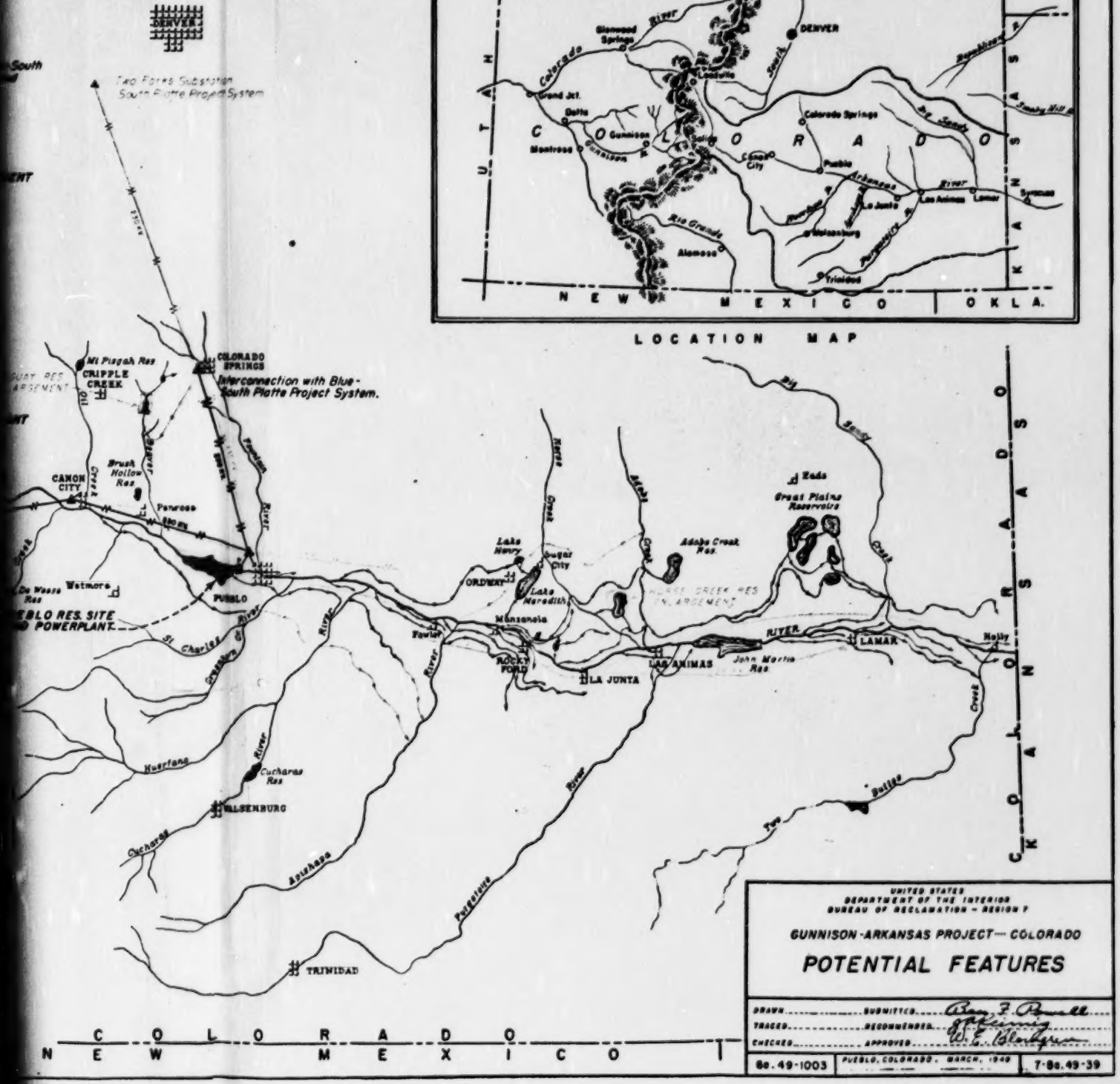
8. Sanitary facilities to be provided at proposed construction camps be installed in accordance with accepted sanitary standards.

Note: Since public health problems to be encountered in connection with the initial development of the Gunnison-Arkansas Project will be the joint responsibility of the U. S. Bureau of Reclamation, U. S. Forest Service, and the Colorado State Department of Health, close cooperation between these agencies is considered essential so that these problems can be solved satisfactorily. A meeting of the three agencies involved would be desirable so that uniform sanitary standards can be adopted for Arkansas Basin developments. The Public Health Service will be glad to assist the agencies referred to in preparing uniform standards for Arkansas Basin developments if the assistance of this agency is considered desirable.


U T A H
C O L O R A D O
GLENWOOD SPRINGS
Eagle River
Roaring Fork
Crystal River
Fryingpan River
RUEDI RES. SITE
FRYINGPAN RIVER DIVERSION
Dillon
Interconnection with Blue
Platte Project System
Colorado-Big Thompson
Project System.
SUGAR LOAF RES. ENLARGEMENT AND POWERPLANT
LEADVILLE
ELBERT POWERPLANT
TWIN LAKES RES. ENLARGEMENT
GRANITE POWERPLANT
WAPACO POWERPLANT
MAROON & CASTLE CREEK DIVERSION
CRYSTAL RIVER DIVERSION
ANTHRACITE CREEK DIVERSION
Colorado
GRAND JUNCTION
Gunnison
North Fork
BRIDGEPORT RES. SITE
GUNNISON
DELTA
Taylor River
TAYLOR PARK RES. ENLARGEMENT AND POWERPLANT
Almont
PRINCETON POWERPLANT
SALIDA POWERPLANT
SALIDA
CURECANTI RES. SITE AND POWERPLANT
MONTROSE
Uncompahgre River
Lake Fork
Cebolla Creek
Tomichi Creek
Texas Creek
N
E X P L A N A T I O N
RESERVOIR
TUNNEL
DIVERSION CANAL (POWER)
IRRIGATION CANAL
PUMPING PLANT
HYDROELECTRIC POWERPLANT
SUBSTATION
TRANSMISSION LINE
INITIAL DEVELOPMENT
MAXIMUM GRAVITY DIVERSION
WESTERN SLOPE DEVELOPMENT AND REPLACEMENT TO BE INTEGRATED WITH GUNNISON-ARKANSAS PROJECT.
Potential municipal water lines not included in project estimate.
10 0 10 20 30
SCALE OF MILES



LOCATION MAP



UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION - REGION 7

GUNNISON-ARKANSAS PROJECT — COLORADO

POTENTIAL FEATURES

DRAWN	SUBMITTED	Ray F. Purcell
TRACED	RECOMMENDED	J. A. Lemmy
CHECKED	APPROVED	W. E. Glanzer

8a.49-1003 | PUEBLO, COLORADO, MARCH, 1949 | 7-8a.49-39